MECKLENBURG COUNTY

FIRE MARSHAL'S OFFICE

Emergency Responder Radio Coverage Systems (ERRCS)

A Guide for Building Owners/Managers, General Contractors, Vendors and Installers of ERRC Systems

January 1, 2019

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1. GENERAL

The North Carolina Fire Code require that the Public Safety Radio System be fully operable in the interior of new buildings and remodeled structures as code permits. Some modern energy-efficient construction techniques and materials (such as Low-E glass, cementitious coatings, and steel roofs) tend to attenuate the radio signals penetrating the exterior of new buildings. Per North Carolina 2018 Fire Code Section 510, all new buildings constructed after January 1, 2019 (except for one- and two-family residences) are required to ensure that the Public Safety Radio System has sufficient radio signal strength to be fully operable throughout the interior of the building.

New building owners subject to the NC 2018 Fire Code Section 510 are required to submit a Radio Signal Strength Study that demonstrates that existing Public Safety Radio System signal levels meet the Code or they will be required to install an Emergency Responder Radio Coverage System (**ERRCS**) to boost the radio signals up to the required levels. Section 510 of the 2018 NC Fire Code for new construction is attached as **Appendix A** at the end of this document. All owners of new buildings, as well as their general contractors and ERRCS vendors/installers, should be familiar with all provisions of the relevant codes and standards. This guide augments those documents with further clarification as to how the codes and standards are implemented.

2. RADIO SIGNAL STRENGTH STUDIES

Any builder owner wishing to demonstrate that the existing radio signal levels inside the building meet the minimum criteria as specified in NC 2018 Fire Code Section 510.4.1 will be required to submit a Radio Signal Strength Study. Such studies will be performed by a suitably qualified engineer or technician with an FCC General Radio Operator's License or acceptable alternative qualifications. Acceptance of alternative technical qualifications will be done on a case by case basis by the Fire Marshal's Office (**FMO**).

Signal studies can only be conducted once the building is permanently enclosed, i.e. all windows, doors, dry wall, exterior coatings and roof in place.

Radio Signal Strength Studies shall be conducted in compliance with the 20-grid method for each floor as outlined in NC 2018 Fire Code Section 510.5.3. In addition to showing one measurement in the center of each grid, the study must also show the signal levels as measured in each Critical Area. Critical Areas (as defined in 2013 NFPA 72 Section 24.5.2.2.1) are fire command centers, fire pump rooms, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, and sprinkler valve locations. Critical Areas will be required to have 99% floor area radio coverage. Documentation submitted shall include a 20-grid floor plan for each floor with signal levels annotated on each grid of the floor plan as well as for all critical areas.

Since the Public Safety Radio System is a multi-site simulcast system, multipath fluctuations can cause the instantaneously measured signal levels to bounce up and down. Personnel conducting signal surveys are encouraged to not use instantaneous signal level readings, but rather sample and average the signal levels for a period of several seconds before recording the signal level for each grid.

For exceptionally large floor areas such as schools and shopping malls, where dividing a large number of square feet into 20 grids creates unreasonably large grids, building owners/managers are strongly encouraged to work with FMO personnel to develop a sampling strategy that does not leave large areas untested. The FMO will work with the owner/manager of such buildings on a case by case basis.

All signal measurements will be conducted using an approved professional-grade spectrum analyzer that has been calibrated within 12 months of the date of the study. A copy of the most recent spectrum analyzer calibration certificate shall be included with the Radio Signal Strength Study.

After submission of the study the building owner will be notified as to whether the results were accepted or whether an ERRCS will be required. The FMO reserves the right do its own signal level spot checks to verify study results.

Radio Signal Strength Study results do not need to be submitted if the building owner has already determined that an ERRCS will be required.

3. ERRCS INSTALLATION

For buildings that fail to meet the criteria for sufficient radio signal levels, an ERRCS will be required. An ERRCS captures the radio signal at the rooftop level through an outdoor donor antenna and carries that signal to the interior of the building where it can be amplified by a Bi-Directional Amplifier (BDA), also known as a signal booster. The amplified signal output of the BDA will normally be redistributed within the building via a Distributed Antenna System (DAS). In some cases, it may be necessary to distribute the amplified signal by a "leaky" coaxial cable method. The amplified signal distributed inside the building should not radiate beyond the perimeter of the building or generate any interference to any licensed radio service.

Per NC 2018 Fire Code section 510.5.1, no ERRCS shall be installed without prior coordination and approval of the FMO. All ERRCS installation plans shall be submitted to the FMO for approval. Upon approval, the building owner/manager will be issued a "Letter of Authorization to Retransmit" the radio frequencies licensed to the Public Safety Agency. (see Section 6-FCC requirements)

As specified in Section 510.3 of the NC 2018 Fire Code for new construction a construction permit is required for any installation or modification of an ERRCS. An ERRCS permit shall be obtained from Mecklenburg County Code Enforcement once the installation plan has been approved. Fees will apply.

Installation of all ERRCS, to include rooftop antenna components and all required electrical wiring, antenna cables, conduits, bonding, grounding, and lightning protection shall be in compliance with all applicable NC building and fire codes.

4. ALARM SYSTEM INTERFACE

Per NC 2018 Fire Code Section 510.4.2.4(3) all ERRCS and backup battery systems shall be electrically supervised and monitored by a supervisory service, or when approved by the fire code official, shall sound an audible signal at a constant attended location. Functions typically

monitored from most ERRCS include donor antenna failure, BDA failure, AC power failure, battery failure, and battery charger failure. Where a fire alarm system is installed these fault modes should normally be transmitted to the fire alarm system and displayed on the annunciator panel. The panel display should clearly identify the fault is an ERRCS failure and also identify the specific ERRCS fault mode. When faults have been rectified, the alarm panel display should automatically reset.

ERRCS failures should be reported to the building owner/manager or the ERRCS vendor so that restoration of radio service can occur as quickly as possible. The supervisory monitoring company should **not** notify the 911 center for a fire response solely because of an ERRCS failure alarm.

The FMO need not be notified for an ERRCS failure unless the outage lasts more than 24 hours. In the event of an outage of more than 24 hours, the Mecklenburg County Dispatch Center should be notified of the outage and asked to pass the message on to the Mecklenburg County Fire Marshal's Office during normal business hours and the on-call fire marshal during nights, weekends or holidays. The same procedure should be used to notify the FMO when the ERRCS system has been restored. The business line for the Mecklenburg County Dispatch Center is (704) 943-6200.

In installations where the ERRCS enclosure is not co-located with the fire alarm panel, the fire alarm panel room will be outfitted with a Knox key switch that can remotely shutdown the ERRCS in the event of a radio interference issue. FMO assistance may be required to procure a Knox key switch.

5. FCC REQUIREMENTS

Beyond the provisions of the NC codes, the Federal Communications Commission (**FCC**) imposes additional rules and regulations on the installation of any ERRCS. All ERRCS designers and installers should be familiar with the provisions of FCC Title 47, Part 90, Section §90.219 (Use of Signal Boosters).

All ERRCS systems shall use only boosters (also known at BDAs) that are type-certified by the FCC.

Per §90.219, the FCC requires that specific documentation be issued to an ERRCS operator that allows the ERRCS system to operate on licensed radio frequencies. As noted above in Section 3, once the ERRCS installation plan has been approved, a Letter of Authorization to Retransmit will be issued to the building owner/manager to cover this requirement. This Letter of Authorization should be stored or displayed prominently on or near the ERRCS enclosure. The Authorization Letters are valid for one year and must be re-issued at each annual re-inspection (see Section 9 – Maintenance & Annual Inspections).

In addition, the FCC requires that all Class B ERRCS systems be registered in the FCC Signal Booster Data Base, which can be accessed online at: www.fcc.gov/signal-boosters/registration

The ERRCS installer is responsible for entering any Class B ERRCS installed in Mecklenburg County into the FCC Signal Booster Database. An FCC Registration Number (**FRN**) is required to enter boosters into the database. If the installer does not already have an FRN, one can be obtained from the FCC CORES system online at: https://apps.fcc.gov/coresWeb/publicHome.do

Once the Class B ERRCS has been registered in the data base, a Booster ID will be issued by the FCC to the applicant. A copy of the Class B booster registration, including the Booster ID, shall be forwarded to FMO. There is no FCC requirement for registration of Class A boosters.

No ERRCS shall transmit on any public safety frequency until the Letter of Authorization to Retransmit has been issued. Additionally, for any Class B ERRCS, the ERRCS shall not transmit on any frequency until the ERRCS has been registered in the FCC data base and the Booster ID number reported to FMO.

6. MINIMUM PERSONNEL QUALIFICATION REQUIREMENTS

Minimum qualification for the ERRCS system designer and lead installer are specified in NC 2018 Fire Code Section 510.5.2. and shall include both of the following:

1. A valid FCC-issued general radio operators license.

2. Certification of in-building system training issued by a nationally recognized organization school or a certificate issued by the manufacturer of the equipment being installed. These qualifications shall not be required where demonstration of adequate skills and experience satisfactory to the *fire code official* is provided.

Any waiver of these requirements will be done on a case-by-case basis by the FMO.

7. ACCEPTANCE TESTING

Acceptance testing for installed ERRCS shall be conducted by FMO personnel using public safety radios in accordance with NC 2018 Fire Code Section 510.5.3. An ERRCS acceptance test can only be conducted once the building is permanently enclosed, i.e. all windows, doors, drywall, roofs, and exterior coatings in place. The building owner can contact FMO to request an ERRCS acceptance test and final inspection once the installation is complete and all alarm interfaces dully tested.

A set of floor plans shall be prepared by the installer with the 20 grids marked off for each floor. The plans should already be annotated with the installer's own spectrum analyzer measurements for all 20 grids on each floor. In buildings with exceptionally large floor areas such as schools and shopping malls, where dividing a large number of square feet into 20 grids creates unreasonably large grids, building owners/managers are strongly encouraged to work with FMO personnel to develop a strategy that does not leave large areas untested. The FMO will work with the owner/manager of such buildings on a case by case basis. In addition to showing one measurement in the center of each grid, the test must also show the signal level as measured in each Critical Area. Critical Areas are defined as fire command centers, fire pump rooms, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, and sprinkler valve locations. Critical Areas will be required to have 99% floor area radio coverage. The annotated

plans will be presented to the FMO personnel conducting the acceptance test at the time of the test (or before the test if possible).

Acceptance testing will also include demonstration of the alarm panel interface, to include simulations of all possible fault modes, as well as the function of the Knox key switch if installed. Final acceptance testing will also include an electrical inspection to ensure compliance with all electrical codes, to include electrical wiring, conduits, antenna cabling, grounding, bonding, and lightning protection.

8. LABELLING

All ERRCS systems should be labelled at the BDA enclosure. The enclosure should be labelled with the words "ERRCS - Emergency Responder Radio Coverage System." In addition, instructions should be posted for how to completely disable the ERRCS in case of radio interference issues. If used, the Knox cutoff switch should be clearly labelled with the words "ERRCS Remote Cutoff Switch."

9. MAINTENANCE & ANNUAL INSPECTIONS

ERRCS shall be maintained operational at all times in accordance with NC 2018 Fire Code Section 510.6 and is the responsibility of the building owner/manager. Results of the annual inspection and test shall be submitted to the FMO to receive a new Letter of Authorization. A new Letter of Authorization to retransmit on the Public Safety Radio Frequencies should be requested by the inspector at the time of the annual inspection. The new Letter of Authorization will then be sent to the inspector and should be posted at the location of the ERRCS system enclosure.

10. PRE-PLANNING

Because the Radio Signal Strength study cannot be performed until the building is nearly complete, and because of the lead time in procuring and installing an ERRCS, building owners/managers are well advised to consider the strong possibility that accommodating an ERRCS installation late in the building process may well delay final building acceptance and

add cost beyond what would have been required for a pre-planned ERRCS. Some steps may be taken during building design and early construction that can help alleviate some of the delays and expense should an ERRCS be required. Such steps would include pre-planning a roof penetration and conduits for the coax cable feeding the roof-top donor antenna as well as ceiling conduits for the interior DAS cabling. Building owners are encouraged to make sure their building designers are aware early-on of the possibility of the need for an ERRCS installation and plan accordingly.

11. ERRCS SERVICE PROVIDERS

Building owner/managers are permitted to use any vendor or contractor they wish to perform Radio Signal Strength studies or to install ERRCS equipment, assuming they meet the minimum qualifications as outlined in Section 6 above. The FMO does not provide a specific list of approved vendors, but as an aid to building owners and general contractors, the FMO will maintain a list of vendors/installers that have successfully installed at least one ERRCS systems that passed acceptance test procedure.

APPENDIX A - NC 2018 FIRE CODE

SECTION 510
EMERGENCY RESPONDER RADIO COVERAGE

510.1 Emergency responder radio coverage in new buildings.

All new buildings shall have *approved* radio coverage for emergency responders within the building based upon the existing coverage levels of the public safety communication systems of the jurisdiction at the exterior of the building. This section shall not require improvement of the existing public safety communication systems.

Exceptions:

1. Where *approved* by the building official and the *fire code official*, a wired communication system in accordance with Section 907.2.13.2 shall be permitted to be installed or maintained instead of an *approved* radio coverage system.

2. Where it is determined by the *fire code official* that the radio coverage system is not needed.

3. In facilities where emergency responder radio coverage is required and such systems, components or equipment required could have a negative impact on the normal

operations of that facility, the *fire code official* shall have the authority to accept an automatically activated emergency responder radio coverage system.

510.2 Deleted

510.3 Permit required. A construction permit for the installation of or modification to emergency responder radio coverage systems and related equipment is required as specified in Section 105.7.5. Maintenance performed in accordance with this code is not considered a modification and does not require a permit.

510.4 Technical requirements. Systems, components and equipment required to provide the emergency responder radio coverage system shall comply with Sections 510.4.1 through 510.4.2.5.

510.4.1 Radio signal strength. The building shall be considered to have acceptable emergency responder radio coverage when signal strength measurements in 95 percent of all areas on each floor of the building meet the signal strength requirements in Sections 510.4.1.1 and 510.4.1.2.

510.4.1.1 Minimum signal strength into the building. A minimum signal strength of -95 dBm shall be receivable within the building.

510.4.1.2 Minimum signal strength out of the building. A minimum signal strength of -95 dBm shall be received by the agency's radio system when transmitted from within the building.

510.4.2 System design. The emergency responder radio coverage system shall be designed in accordance with Sections 510.4.2.1 through 510.4.2.5.

510.4.2.1 Amplification systems allowed. Buildings and structures that cannot support the required level of radio coverage shall be equipped with a radiating cable system, a distributed antenna system with Federal Communications Commission (FCC)-certified signal boosters, or other system approved by the *fire code official* in order to achieve the required adequate radio coverage.

510.4.2.2 Technical criteria. The *fire code official* shall maintain a document providing the specific technical information and requirements for the emergency responder radio coverage system. This document shall contain, but not be limited to, the various frequencies required, the location of radio sites, effective radiated power of radio sites, and other supporting technical information.

510.4.2.3 Standby power. Emergency responder radio coverage systems shall be provided with standby power in accordance with Section 604. The standby power supply shall be capable of operating the emergency responder radio coverage system for a duration of not less than 24 hours.

510.4.2.4 Signal booster requirements. If used, signal boosters shall meet the following requirements:

1. All signal booster components shall be contained in a National Electrical Manufacturer's Association (NEMA) 4-type waterproof cabinet.

2. Battery systems used for the emergency power source shall be contained in a NEMA 4-tYpe waterproof cabinet.

3. The signal booster system and battery system shall be electrically supervised and monitored by a supervisory service, or when *approved* by the *fire code official*, shall sound an audible signal at a constantly attended location

4. Equipment shall have FCC certification prior to installation.

510.4.2.5 Additional frequencies and change of frequencies. The emergency responder radio coverage system shall be capable of modification or expansion in the event frequency changes are required by the FCC or additional frequencies are made available by the FCC.

510.5 Installation requirements. The installation of the public safety radio coverage system shall be in accordance with Sections 510.5.1 through 510.5.4.

510.5.1 Approval prior to installation. Amplification systems capable of operating on frequencies licensed to any public safety agency by the FCC shall not be installed without prior coordination and approval of the *fire code official*.

510.5.2 Minimum qualifications of personnel. The minimum qualifications of the system designer and lead installation personnel shall include both of the following:

1. A valid FCC-issued general radio operators license.

2. Certification of in-building system training issued by a nationally recognized organization, school or a certificate issued by the manufacturer of the equipment being installed. These qualifications shall not be required where demonstration of adequate skills and experience satisfactory to the *fire code official* is provided.

510.5.3 Acceptance test procedure. Where an emergency responder radio coverage system is required, and upon completion of installation, the building *owner* shall have the radio system tested to verify that two-way coverage on each floor of the building is not less than 90 percent. The test procedure shall be conducted as follows:

1. Each floor of the building shall be divided into a grid of 20 approximately equal test areas.

2. The test shall be conducted using a calibrated portable radio of the latest brand and model used by the agency talking through the agency's radio communications system.

3. Failure of not more than two nonadjacent test areas shall not result in failure of the test.

4. In the event that three of the test areas fail the test, in order to be more statistically accurate, the floor shall be permitted to be divided into 40 equal test areas. Failure of not more than four nonadjacent test areas shall not result in failure of the test. If the system fails the 40-area test, the system shall be altered to meet the 90-percent coverage requirement.

5. A test location approximately in the center of each test area shall be selected for the test, with the radio enabled to verify two-way communications to and from the outside of the building through the public agency's radio communications system. Once the test location has been selected, that location shall represent the entire test area. Failure in the selected test location shall be considered failure of that test area. Additional test locations shall not be permitted.

6. The gain values of all amplifiers shall be measured, and the test measurement results shall be kept on file with the building *owner* so that the measurements can be verified during annual tests. In the event that the measurement results become lost, the building *owner* shall be required to rerun the acceptance test to reestablish the gain values.

7. As part of the installation a spectrum analyzer or other suitable test equipment shall be utilized to ensure spurious oscillations are not being generated by the subject signal booster. This test shall be conducted at the time of installation and subsequent annual inspections.

510.5.4 FCC compliance. The emergency responder radio coverage system installation and components shall also comply with all applicable federal regulations including, but not limited to, FCC 47 CFR Part 90.219.

510.6 Maintenance. The emergency responder radio coverage system shall be maintained operational at all times in accordance with Sections 510.6.1 through 510.6.3.

510.6.1 Testing and proof of compliance. The emergency responder radio coverage system shall be inspected and tested annually or where structural changes occur including additions or remodels that could materially change the original field performance tests. Testing shall consist of the following:

1. In-building coverage test as described in Section 510.5.3.

2. Signal boosters shall be tested to verify that the gain is the same as it was upon initial installation and acceptance.

3. Backup batteries and power supplies shall be tested under load of a period of 1 hour to verify that they will properly operate during an actual power outage. If within the 1-hour test period the battery exhibits symptoms of failure, the test shall be extended for additional 1-hour periods until the integrity of the battery can be determined.

4. Other active components shall be checked to verify operation within the manufacturer's specifications.

5. At the conclusion of the testing, a report, which shall verify compliance with Section 510.5.3, shall be submitted to the *fire code official*.

510.6.2 Additional frequencies. The building *owner* shall modify or expand the emergency responder radio coverage system at his or her expense in the event frequency changes are required by the FCC or additional frequencies are made available by the FCC. Prior approval of a public safety radio coverage system on previous frequencies does not exempt this section.

510.6.3 Field testing. Agency personnel shall have the right to enter onto the property at any reasonable time to conduct field testing to verify the required level of radio coverage.